EXHIBIT A

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

IN RE NEW ENGLAND COMPOUNDING PHARMACY, INC. PRODUCTS LIABILITY LITIGATION	MDL No. 2419 Dkt. No. 1:13-md-2419 (RWZ)
THIS DOCUMENT RELATES TO: All Actions	

DECLARATION OF DR. PHILIP J. AUSTIN, PH.D.

1. At the request of the Plaintiffs' Steering Committee ("PSC") in MDL 2419, In Re New England Compounding Pharmacy, Inc. Products Liability Litigation, 13-md-2419-RWZ (D. Mass.), I have prepared the following expert declaration in connection with the cleanrooms built by Liberty Industries, Inc. ("Liberty") at and for use by the New England Compounding Center ("NECC"), in Framingham, Massachusetts. After reviewing documents and undertaking a physical inspection of the cleanrooms at NECC, I have now been requested to provide this declaration concerning the design, construction, and commission of the cleanrooms and what, if any, effect this had on the contamination of drugs compounded within the cleanrooms.

I. PROFESSIONAL BACKGROUND

I received a Bachelor of Science (1988), Master of Science (1990), and Doctor of Philosophy (1994) in Aerospace Engineering from the University of Michigan, Ann Arbor. Upon completion of my doctorate, I accepted a National Research Council postdoctoral appointment at the National Institute of Standards and Technology in Gaithersburg, Maryland. In 1996, I returned to Michigan to serve as the Director of Research for Acorn Industries, providing expert services related to cleanrooms, cleaning, and contamination control. As Director of Research for the past 18 years, I have been responsible for the majority of engineering activities which include cleaning process development, design of cleanroom

facilities and custom cleaning equipment, technical sales, and consulting services. I have worked with Acorn Industries and with hundreds of customers in the pharmaceutical and other cleanroom-related industries as an expert resource defining cleanliness requirements, troubleshooting contamination issues, developing cleaning processes, designing cleanrooms, training cleanroom personnel, and qualifying cleanrooms and cleanroom construction materials for use. A copy of my curriculum vitae is attached hereto.

II. COMPENSATION

2. I am being compensated for my work in this case at $200.00 per hour. No part of my compensation due or received is contingent upon the outcome of this litigation.

III. MATERIALS REVIEWED

3. In preparation of this declaration, I have considered the observations made by Dr. Philip R. Austin and me during the three day inspection of NECC in December 2012. I also relied upon information, including photographs and test results taken and reported by Thomas Irmiter of Forensic Building Science, the chief environmental expert and investigator designated by plaintiffs and their counsel to coordinate the inspection of NECC by various professionals and experts in December 2012. I have also reviewed Liberty's motion for summary judgment and exhibits.

IV. SUMMARY OF OPINIONS

4. It is my opinion that, to a reasonable degree of scientific certainty, Cleanroom 1, designed and constructed by Liberty Industries, was improperly designed and installed to ensure its intended use for the compounding of sterile injectable drugs. As the primary contractor responsible for the finished cleanroom, Liberty Industries was responsible for ensuring that the cleanroom was properly constructed, in all aspects, to be able to provide the required cleanliness environment for compounding sterile injectable drugs.

5. Based on the evidence currently available to me which includes my observations of defects in the ceiling of the cleanroom, the size and composition of the debris observed in the area of the defects, and my understanding of the likely operations performed in the cleanroom in the area of the defects, it is my opinion, to a reasonable degree of scientific certainty, that Liberty's failure to design and construct Cleanroom 1 was a proximate cause of the fungal contamination in NECC's cleanroom.

V. TECHNICAL BACKGROUND INFORMATION ON CLEANROOMS AND CONTAMINANTS

6. A cleanroom is an environmentally controlled production space that is specifically designed to control various forms of contamination within the space. In this context, the term "contamination" refers to any type of substance that would be detrimental to the products or processes being performed in the cleanroom; however, cleanrooms are most often designed for the purpose of controlling various forms of particulate contamination.

A. Types of Particulate Contamination

7. Particulate contamination can be composed of living or non-living material, or a combination of both. Typical living particles are bacteria, viruses, mold, and fungi. These types of living particles are often referred to as viable particles, referring to their ability to reproduce. Non-living particles can be made of anything that can be divided into small pieces through natural processes such as abrasion or erosion, or deliberate application of force to the material. Because these particles do not reproduce, they are often referred to as non-viable particles in a context where viable particles are of critical concern.

8. In a typical production environment, the most common non-living particles are hair, plant material, dead skin cells, sand, dirt, clothing particles, animal fur, animal dander, insect parts, packaging materials, plastic particles, glass particles, and metal particles. Such non-

living particles are present in a large range of sizes, from particles smaller than 1 millionth of a meter (micrometer) that are only visible under a microscope, to particles that are several millimeters long. Living particles typically have a much more narrow range of sizes that are less than a micrometer to only a few dozen micrometers, unless the living particles attach to each other or to non-living particles in groups.

9. Particulate contamination is usually thought of as solid particles such as dust, but it can also take the form of liquid droplets. These liquid droplets can in turn be carriers of small solid particles, particularly living particles.

10. Particulate contamination is pervasive in the air that we breathe and on the surface of every object that we encounter. While most of this contamination is largely invisible to us in our everyday activities, we become acutely aware of it when we see a dusty surface or notice the collection of particles floating in the air that are illuminated by a beam of sunlight in a dimly lit room. What we see in these instances are only the largest of the particles, which are visible, and only represent a small fraction of the number of particles that are actually present. The air that we breathe every day typically contains more than 1,000,000 particles larger than 0.5 microns per every cubic foot of air volume. In a production environment where such contaminants pose a risk to the product being manufactured or serviced, these contaminants must be eliminated or significantly reduced.

B. How Cleanrooms Control Particulate Contamination

11. Cleanrooms are designed to control the presence and generation of particulate contamination in a designated area. A cleanroom is an enclosed space which can be made up of one room or a series of connected rooms. The airborne contaminants in a cleanroom are controlled through the use of a special air filtration system that is designed to remove the particulate laden air from the room and replace it with filtered air which has a significantly

smaller concentration of particles. A typical cleanroom makes use of HEPA filters which are designed to remove 99.99% of all particles that are 0.5 micrometers and larger in the air that is passed through the filter. The size of the room, the number of HEPA filters, and the airflow pattern within the room are the primary factors which determine the effectiveness of the air filtration system in reducing the number of airborne contaminants within the room.

12. The contaminants in a cleanroom are also controlled by the design of the room and the materials used in the construction of the room. The cleanroom should be constructed of solid, non-porous materials that do not shed and are resistant to abrasion. A well designed cleanroom should be completely enclosed, with all surfaces, joints, ductwork, piping, tubes, and utility access openings sealed to prevent the unwanted entry of contaminants into the room. Any openings in the cleanroom provide a path for particles to enter into it via airflow into the room or gravitational settling. In particular, ceilings and wall surfaces above work surfaces within the cleanroom should be well sealed to prevent contaminants from entering via gravitational action. If such openings in a cleanroom are present, contaminants may “rain” down into the cleanroom.

13. The airborne contaminants in the cleanroom are usually further controlled through the use of air pressure which prevents contaminated air from entering into the cleanroom. In this case, the filtration system is designed to maintain the cleanroom at a small positive pressure relative to its exterior environment. Because air moves from an area of high pressure to an area of lower pressure, the higher pressure in the cleanroom results in the flow of clean air through any imperfections and gaps in the cleanroom enclosure. This flow of clean air through such gaps inhibits the flow of contaminated air into the cleanroom through these gaps.

14. Another factor which has a significant effect on the cleanliness within a cleanroom is the nature of operations that are performed within the cleanroom. Manufacturing

processes and equipment that operate within the cleanroom can generate significant amounts of contaminants which must be removed from the room in order to protect the cleanliness of operations being performed within the cleanroom. Also, personnel activity within the cleanroom can also have an impact on the cleanliness of the cleanroom, as human activity can generate large quantities of both living and non-living particles. A cleanroom that is properly designed should account for the generation of these contaminants within the room and provide for their efficient removal from the room.

C. Types and Classifications of Cleanrooms

15. Cleanrooms are often classified by the type of work that is to be performed in the cleanroom or the types of contaminants that are of primary concern in the cleanroom. Cleanrooms that are designed to specifically control biological contaminants (living particles) are typically referred to as bio-cleanrooms or aseptic cleanrooms. Such cleanrooms are used in the manufacture of certain pharmaceuticals and medical devices, and to provide services that require the absence of living particles. For cleanrooms in which there is no special requirement to control biological contaminants, there is no special designation. Such cleanrooms are used in the manufacture of automotive parts, electronics, semiconductors, aerospace parts, and other items that require an environment that is free from particulate contamination. For these types of cleanrooms, there is generally little concern whether the particles in the room are living or non-living.

16. Cleanrooms are also classified by the design of the airflow pattern within the room: turbulent flow or laminar flow. Cleanrooms can have a turbulent airflow design in which the HEPA filtered air is mixed with the “dirty” air in the cleanroom to gradually reduce the concentration of airborne particles present within the cleanroom by dilution. In such cleanrooms, the HEPA filters are typically dispersed in the ceiling of the cleanroom, covering an

area of the ceiling that is proportional to the desired level of air cleanliness within the cleanroom. The air from these filters is discharged into the cleanroom and mixes with the air inside of the cleanroom. The placement of the filters is typically designed to maximize the efficiency of the mixing process. As the filtered air is mixed with the air within the cleanroom, the concentration of particles in the air within the cleanroom is decreased by a dilution effect. The mixed air is then drawn out of the room through vents which recirculate a portion of the air through the filtration system. The manner in which a turbulent cleanroom reduces the concentration of airborne particles is similar to an air conditioning system in which cold air is introduced into a room, mixes with the warmer air in the room, and thereby lowers the temperature of the air in the room.

17. Cleanrooms can also have a more efficient airflow design, known as laminar airflow, in which the HEPA filtered air completely displaces the "dirty" air in the cleanroom. This type of cleanroom airflow was invented in 1962 to improve the capability of cleanrooms to provide lower airborne particulate levels. For this type of cleanroom, the HEPA filters cover the entire ceiling or one entire wall of the cleanroom. If the entire ceiling of the room is covered with HEPA filters, the cleanroom is designated as a vertical laminar flow cleanroom. If an entire wall of the room is covered with HEPA filters, the cleanroom is designated as a horizontal laminar flow cleanroom. For the vertical flow cleanroom design, the air flows from the ceiling HEPA filters directly down to the perforated floor of the cleanroom. The floor of the cleanroom sits above a return air plenum in which the air from the cleanroom is collected and recirculated through the filtration system. For the horizontal cleanroom design, the wall of the cleanroom that is opposite the wall of HEPA filters sits in front of a return air plenum in which the air from the cleanroom is collected and recirculated through the filtration system.

18. In the laminar flow cleanroom design, as the air is discharged from the HEPA filters, it does not mix with the air inside of the cleanroom; instead, the air from the filters "pushes" the "dirty" air through the cleanroom to the return air plenum, completely displacing the air in the cleanroom. In order for this type of cleanroom to function properly, the air velocity must be maintained at a relatively low velocity in the range of 100 feet per minute. This ensures that the body of air from the filters remains together as it moves through the cleanroom environment. The laminar flow cleanroom can be thought of as a low speed wind tunnel in which the air being supplied to the wind tunnel is HEPA filtered.

19. From an airborne cleanliness standpoint, the laminar flow cleanroom design is capable of producing a much cleaner environment because it is constantly removing all particles in the airstream by pushing them through the room to the return air plenum. The air inside of the cleanroom is continuously being completely replaced with HEPA filtered air; thus, any particles which may be generated inside of the cleanroom are quickly swept out of the cleanroom. By contrast, the turbulent airflow design will allow some particles to persist for a substantial amount of time in the air because the turbulent flow design relies on a dilution principle. In such a cleanroom, pockets of dirty air can be present which will only slowly be diluted by the mixing process. For this reason, the laminar flow cleanroom design is the preferred design for critical applications, particularly those in which strict control of living (viable) particles is required.

D. Classification and Certification of Cleanrooms per ISO 14464-1

20. Cleanrooms are also classified by their level of cleanliness, as determined by special measurements made in accordance with standards that are used to define the level of cleanliness within the cleanroom. In this regard, the concentration of particles within the cleanroom is measured and compared to a standard (ISO 14644-1) that defines classes of cleanroom cleanliness based on the concentration of airborne particles within the room.

21. ISO 14644-1 is an international standard which establishes "classes" of cleanroom cleanliness based on the measured concentration of airborne particles within the room. The concentration of particles within the room is measured using a special instrument called an airborne particle counter. This instrument ingests samples of air from the cleanroom and passes them through a detection cell which counts and sizes the particles. The instrument then reports the concentration of particles present in the air at various particle size thresholds. This concentration can then be compared to levels established by the ISO standard that define the cleanliness class of the cleanroom based on the particle concentration.

22. The levels of cleanliness defined by ISO 14644-1 were developed in conjunction with work that led to the publication of Federal Standard 209: the first public standard to define the levels of airborne particulate cleanliness within a cleanroom. The levels of cleanliness as defined in Federal Standard 209 were intuitive in that the defined cleanliness level corresponded to the number of particles larger than 0.5 micrometers in a cubic foot air sample. For example, a cleanroom designation of Class 100 defined a cleanroom with less than 100 particles per cubic foot of air that are 0.5 micrometers and larger, while a cleanroom designation of Class 10,000 defined a cleanroom with less than 10,000 particles per cubic foot of air that are 0.5 micrometers and larger. The standard also established limits for other particle sizes for the various cleanliness classes which could be used, at the discretion of the entity certifying the cleanroom, to determine compliance with a given cleanliness classification.

23. While Federal Standard 209 persisted as the public standard for defining cleanroom cleanliness for over 30 years, it was eventually replaced by ISO 14644-1 in 1999. ISO 14644-1 is a standard that was issued by the ISO (International Standards Organization). As was done for other standards issued by the US government or US military, the new ISO standard

was issued to replace a standard that was controlled by the United States with a standard that could be controlled by the international community through the ISO. While some aspects of Federal Standard 209 were modified in the ISO standard to reflect progress in the technology of cleanroom design, the basis for the definition of the airborne cleanliness levels was not changed. In this regard, the ISO standard essentially converted the Federal Standard 209 cleanliness classes to metric units and changed their names accordingly. The current system of classifying cleanroom cleanliness is less intuitive but equally valid. In general, what was referred to as a Class 100 cleanroom in Federal Standard 209 is now referred to as an ISO Class 5 cleanroom in ISO 14644-1. Similarly, a Class 1,000 cleanroom is now an ISO Class 6, a Class 10,000 cleanroom is now an ISO Class 7, and a Class 100,000 cleanroom is now an ISO Class 8.

24. Despite the adoption of the ISO standard to replace Federal Standard 209, the cleanroom industry continues to use the class designations of the Federal Standard. This is done, primarily in the USA, because the designations for the Federal Standard 209 cleanliness classes are more easily understood and because of the long history of using this nomenclature to specify the cleanliness of a cleanroom environment.

25. According to the ISO standard, cleanrooms can be certified as meeting the requirements of a particular class if they meet specific criteria. The standard defines the process for determining if a cleanroom meets the specified criteria for a given cleanliness class designation by testing the airborne particle concentration within the room. The standard defines limits for the concentrations of particles of various sizes for each of 9 different cleanliness classes: ISO Class 1 through ISO Class 9. Each decrement of one cleanliness class represents an environment that is ten times cleaner; therefore, a Class 7 cleanroom is 10 times cleaner than a

Class 8 cleanroom, and a Class 6 cleanroom is 10 times cleaner than a Class 7 cleanroom and 100 times cleaner than a Class 8 cleanroom.

26. The ISO standard allows for the testing and certification of a cleanroom under three different operational states: as built, at rest, and operational. The "as built" state is defined by the condition of the cleanroom after completion of construction, but without the presence of production equipment, product, and personnel within the room at the time of testing. Testing in the "as built" state is usually designed to demonstrate the performance of a newly constructed cleanroom prior to installation of equipment into the cleanroom which could alter the performance of the cleanroom.

27. The "at rest" state is defined by the condition of the cleanroom after completion of construction and installation of all production equipment required for normal production activities to be performed within the room. Testing in the "at rest" state is performed without personnel present in the room at the time of testing, and is typically performed while production equipment is not actively moving. Passive production equipment such as refrigerators, non-moving lab instruments, and electronics may be operational during "at rest" testing with little to no effect on the test results; while active equipment such as conveyors, robotic transfer equipment, and other items that actively move while in operation can significantly affect the test results. As such, active equipment is usually kept dormant during "at rest" testing. Testing in the "at rest" state is designed to demonstrate the performance of the fully operational cleanroom without the variables of human activity and active equipment movement within the cleanroom.

28. The "operational" state is defined by the condition of the cleanroom in its fully operational condition. Testing is performed for the cleanroom during normal production activities with equipment operating as it would during normal production and with personnel

present, performing their normal production activities. Testing in the "operational" state is designed to demonstrate the performance of the cleanroom under the same conditions for which production activities will be performed. This type of testing provides the most accurate representation of the levels of contamination to which a product will be exposed, and provides the most accurate measure of how well a cleanroom has been designed to provide particulate control for the processes being performed within the cleanroom. Testing in the "operational" state allows for the identification of specific contamination issues that can affect the quality of the product being manufactured or process being performed within the cleanroom.

E. Standards Which Apply to the Construction of Cleanrooms

29. While certification of cleanrooms is typically performed according to the requirements of ISO 14644-1, this is not the only standard that governs the proper design and operation of cleanrooms. ISO 14644-1 is merely the standard which is used to certify that a cleanroom is complaint with certain required levels of airborne particulate cleanliness. Testing in accordance with ISO 14644-1 is only the last step that is typically performed to confirm that a newly constructed cleanroom is functioning properly; however, it is not the only criterion for certification of a cleanroom as being suitable for use. ISO 14644-1 does not address the proper design and construction of a cleanroom, nor does it address unacceptable forms of contamination that are not measured using standard airborne particle count testing.

30. ISO 14644-1 is only one part of a series of standards which govern the proper design and operation of cleanrooms. These ISO standards are collectively referred to under the general title of "Cleanrooms and Associated Controlled Environments". These other standards have designations 14644-2 through 14644-14. While ISO 14644-1 is used to measure levels of airborne particulate cleanliness in a cleanroom, other tests that are recommended for the commissioning of a cleanroom are listed in ISO 14644-3. Of specific interest to an entity

responsible for the design and construction of a cleanroom, ISO 14644-4 lists requirements for the design, construction, and start-up of a new cleanroom which must be followed. It should be noted that the Foreword of each section of ISO 14644, including ISO 14644-1, references the section numbers and topics of the other ISO 14644 sections.

31. ISO 14644-4 specifically addresses the design, construction, and start-up requirements for a cleanroom. It establishes a list of requirements for the cleanroom to be agreed upon between the purchaser and supplier. It also outlines the proper process for planning and design of the cleanroom. In both of these sections of the document, it specifically addresses the intended use of the cleanroom and the ability of the cleanroom to provide a sufficiently clean environment for its intended purpose. ISO 14644-4 outlines a series of activities required for installation and approval of a cleanroom. Certification according to ISO 14644-1 is only one component of the required approval process. ISO 14644-4 also establishes specific requirements for the materials of construction and design of the cleanroom. Of particular note, it requires ceiling and wall systems to be sealed, to prevent ingress of unwanted particles into the cleanroom.

32. In addition to the ISO 14644 series of standards, other standards such as ISO 14698 and USP <797> define the requirements of cleanrooms to be used for the compounding of drugs.

VI. INVESTIGATION AND INSPECTION OF NECC FACILITIES

33. In December of 2012, my father, Dr. Philip R. Austin, and I were retained as consultants with expertise in the area of cleanroom design and contamination control. We were granted access to the NECC facility, under the supervision of federal agents and lawyers representing NECC, for a three day period in December of 2012. The purpose of our

investigation was to document the conditions of the facility and attempt to identify the likely cause(s) of the contamination of vials of MPA with fungus.

34. During our investigation, we inspected the interior of the facility and parts of the exterior on a limited basis, with our primary focus on the cleanrooms used for compounding. At the start of our investigation, we did not have any information regarding where the contaminated MPA was compounded. During our investigation, our observations led us to the conclusion that the contaminated MPA was most likely compounded in the main area of the 2006 cleanroom ("Cleanroom 1"), which we later learned was designed and installed by Liberty Industries. Information obtained since that time also appears to support the conclusion that the contaminated MPA was compounded in the main area of the 2006 cleanroom. For this reason, our analysis here is focused on this cleanroom area.

35. During our inspection of the cleanroom in December of 2012, we identified several defects in the design and construction of the NECC cleanrooms. In particular, it was our conclusion that the most probable vector for the contamination was directly related to a defect in the design and construction of the main area of the 2006 cleanroom. Although we have been provided with additional information since our initial investigation, we still believe that the defects in the design and construction of the NECC cleanrooms played a key role in the contamination of the vials of MPA.

A. Design of Cleanroom 1

36. Cleanroom 1 was designed as a system of four attached cleanrooms. The main area of the cleanroom is a large ISO Class 6 cleanroom with several smaller support cleanrooms sharing a common wall with the main area of the cleanroom. The main area of the cleanroom consists of an area of approximately 2,400 square feet which was designed as an ISO Class 6 cleanroom. This cleanroom is designed as a turbulent flow cleanroom, with 76 or 77 HEPA

filters distributed across the ceiling surface, and air return plenums at various locations along the walls and central support pillar of the cleanroom. Attached to the main area of the cleanroom is a support cleanroom, called the Preparation Room, which was designed as a turbulent flow ISO Class 7 cleanroom. This area is approximately 480 square feet and was presumably designed for support activities for the main cleanroom area. Entrance to the main area of the cleanroom is through this Preparation Room. Adjacent to the Preparation Room on one side is the Personnel Anteroom and on the other side is the Freight Anteroom. The Personnel Anteroom is designed as a turbulent flow ISO Class 6 cleanroom while the Freight Anteroom is designed as a turbulent flow ISO Class 8 cleanroom. The Personnel Anteroom has an area of approximately 220 square feet and is designed as a room through which cleanroom personnel gain access to the system of cleanrooms. Cleanroom personnel enter into this room, change into special cleanroom garments that are designed to limit their emission of particles in the cleanroom, and then proceed into the Preparation Room. As needed, the personnel will move between the Preparation Room and the main area of the cleanroom depending on the activities that they are required to perform. The Freight Anteroom, which is approximately 480 square feet, serves a similar function to the Personnel Anteroom. Raw materials are brought into the Freight Anteroom and made suitable for entry into the main area of the cleanroom.

37. The cleanrooms were constructed using a modular design with wall segments that were designed to fit together to form a sealed enclosure. The ceiling was designed to be suspended from above using a ceiling tile style grid system. The grid system was designed to hold the weight of ceiling panels, light fixtures, and HEPA filter modules that formed the ceiling surface of the cleanroom enclosure. In order for the cleanroom to function properly, it was necessary that the joints between the wall panels be properly fitted together and sealed to prevent

contaminants from entering into the cleanroom. In a similar fashion, it was necessary for the ceiling panels, light fixtures, and HEPA filters to fit properly inside of the ceiling grid to prevent contaminants from entering into the cleanroom.

38. The Personnel Anteroom and Freight Anteroom were designed to operate at a slight positive pressure relative to their external environment. The Preparation Room was designed to operate at a slight positive pressure relative to the Personnel Anteroom and Freight Anteroom, and the main area of the cleanroom was designed to operate at a slight positive pressure relative to the Preparation Room.

B. Defects in the Design and Construction of Cleanroom 1

39. The available information indicates that the contaminated vials of MPA were compounded in the main area of the cleanroom. As such, the discussion of the defects in the design and construction of the 2006 cleanroom is focused on this area of the cleanroom.

40. During our inspection of the cleanroom in December of 2012, it was observed that the ceiling system of the cleanroom was improperly designed and installed. We observed gaps between some of the light fixtures and the ceiling grid. We also observed similar large gaps between some of the HEPA filters and the ceiling grid. These light fixtures and filters should rest inside of the T shaped ceiling grid elements, with their perimeter sealing against a gasket resting on the lip of the grid elements. The weight of the lights and HEPA filters, if properly installed, should provide sufficient pressure to provide a seal that prevents contaminants from entering into the cleanroom.

41. In order for the ceiling to properly function as a barrier from contaminants entering into the cleanroom, the entire perimeter of the light fixture or filter must seal against the gasket in the grid, with no gaps or holes through which particles can enter into the cleanroom below. In the case of the main cleanroom area, gaps were observed between the grid and some

of the filters and light fixtures. In particular, one filter unit was observed to have a gap larger than 1/4" wide at its widest point, running the length of the HEPA filter on two sides, between its perimeter and the ceiling grid. When viewed from above the ceiling, one could look directly down into the cleanroom below. This gap provided for direct entry of contaminants into the cleanroom through both open unrestricted airflow and gravitational settling.

42. Of particular interest was the fact that significant amounts of debris were observed adjacent to this gap on top of the HEPA filter and adjacent lights and ceiling tiles. Most significant among the types of debris discovered were pieces of rotting wood, of various shapes and sizes, in a distribution pattern which indicated that similar debris would have fallen through the open gap in the ceiling. Rotting wood is a significant source for a variety of species of mold and fungi. Of further significance is the observation that this gap was directly above an area in which it is believed that compounding of drugs was performed.

43. Based on the size and appearance of some of these gaps in the ceiling, I believe that these defects were present as a result of the initial installation of the ceiling system. There was no observed evidence to suggest that any modifications to the ceiling had been made in these areas. Furthermore, the design of the ceiling would have made it extremely difficult for any such modifications that would have resulted in the formation of these gaps to be made without a complete replacement of the ceiling. The gaps in the ceiling were systemic based on an improper alignment of the fixed grid elements which made it impossible to seal the affected grid openings with the materials (lights, filters, and ceiling panels) designed to rest inside of the openings to seal against the grid. This means that even if a HEPA filter module was later adjusted after installation of the ceiling, it would have been impossible to position the filter in the grid without the presence of a gap between the filter and the grid.

44. In addition to the defective installation of the ceiling system, it was also observed that sprinkler heads for the fire suppression system were improperly installed. Openings for the sprinkler heads were cut into the ceiling panels and the holes were not well fit to the heads. As such, gaps between the ceiling panels and the sprinkler heads were observed. As with the gaps around the light fixtures and HEPA filters, these holes in the ceiling provided an unobstructed route of entry for contaminants into the cleanroom from above.

45. It can be argued that the positive pressure design of the cleanroom should mitigate the effect of imperfections in the cleanroom design by preventing the flow of contaminated air through these unsealed openings; however, the magnitude and location of the defects that were observed neuter this argument. While positive pressure can provide resistance to the flow of contaminated air into the cleanroom, the positive pressure is only effective to the extent that the induced air flow can support the weight of any given particle. For particles of larger size or greater density, the positive pressure airflow provides insufficient force to prevent entry of these particles into the cleanroom. In the case of the defects that were observed in the main area of the cleanroom, the holes were large and provided direct access to particles from gravitational settling. The amount of air flow through these openings, even under optimal conditions, would be insufficient to resist larger particles of solid debris or liquid droplets from entering into the cleanroom. The size and types of particles that were observed resting on the exterior surfaces of the ceiling panels, filters, and light fixtures would not be prevented from entering into the cleanroom by the positive pressure effect.

46. In addition, the fact that some of these gaps were observed adjacent to the HEPA filter modules means that the positive pressure effect would have been reduced or even reversed

due to entrainment[1] of the surrounding air by the air being discharged from the HEPA filter. The same principle that is used in the design of a turbulent flow cleanroom to encourage mixing of the air is responsible for this entrainment effect. As the air flows out of the HEPA filter, the air adjacent to the filter is drawn into the air stream. This creates a circulation pattern in the area adjacent to the filter. This circulation pattern creates a slight negative pressure along the ceiling surface next to the filter, as the surrounding air is being entrained. This phenomenon is known as a Venturi effect. This slight negative pressure is harmless unless there is a gap in the ceiling next to the filter. In this case, the slight negative pressure can draw contaminated air into the cleanroom through the gap, and mix it with the clean air being discharged from the HEPA filter. This effect can be visualized by picturing how, as the water from a waterfall falls into a pool of water below; it pulls the surrounding water from the surface of the pool down with it, creating a churning mixture of the water from the waterfall and the water from the collecting pool below. Based on our observations of some of the HEPA filters, it is likely that such entrainment of contaminants was occurring in the main area of the cleanroom, drawing small amounts of contaminated air into the cleanroom through these unsealed openings in the ceiling.

47. It was observed that Cleanroom 1 was constructed in a warehouse style building that was more than 100 years old. The construction of such a cleanroom within a building of this type requires special considerations for the interaction of the cleanroom with the surrounding building environment. In particular, the roof above the cleanroom was known to be old and in poor condition, making it likely that the roof would leak and shed debris which would fall onto the cleanroom below. In a statement from Jeffrey Erickson, the Liberty Industries site manager for the construction of the NECC cleanrooms, it is noted that he observed roof repairs being

[1] Entrainment in this context describes a phenomenon by which ambient air is pulled along in the same direction as air flowing out of the HEPA filter.

made above Cleanroom 1 during its construction, indicating his awareness of the condition of the roof. For such a cleanroom installation, in which it is likely that the ceiling of the cleanroom will be exposed to higher than usual amounts of contamination, and for which the intended purpose of the cleanroom requires safeguards from such contaminants falling into the cleanroom through the ceiling, a hardcap ceiling should be installed to protect the grid style ceiling system.

48. The construction of the cleanroom within such a large warehouse space also made the cleanroom susceptible to rapid pressure fluctuations which occur within such a space as a result of external weather conditions. Wind blowing against a building of this style, size, and age can cause rapid pressure fluctuations within the building. These pressure fluctuations can exceed the pressure differential that was used to maintain the positive pressure effect between the main cleanroom and the surrounding warehouse environment. As a result, periodic pressure inversions would have likely occurred which would force contaminants through any cracks, holes, or other openings in the cleanroom ceiling and into the cleanroom below. The pressure fluctuations in the building can also create excess negative pressure in the space above the cleanroom ceiling. This can be problematic if it creates sufficient force on the ceiling panels to lift them out of the ceiling grid. This can cause a profuse entrance of contaminants into the cleanroom as the ceiling panel is either unseated or flutters within the grid. Special hold down clips are typically used to anchor the ceiling panels to the grid in order to mitigate this effect; however, documents that I reviewed indicated that NECC experienced such problems with the ceiling panels after completion of the cleanroom. For such an installation environment, in which rapid pressure fluctuations in the area above the ceiling can be expected, a hardcap ceiling should have been used to act as a barrier to isolate the ceiling from the effects of these pressure fluctuations.

C. Insufficiency of ISO 14644-1 Testing to Demonstrate Cleanroom Compliance

49. According to the documents that I reviewed, Cleanroom 1 was tested and certified by Liberty Industries at some time near its completion. It appears that the testing was to be performed in accordance with the specified ISO 14644-1 cleanliness classes in the "at rest" condition; however, the testing was actually performed prior to the "as built" condition. Although testing for compliance with ISO 14644-1 is only one requirement for successful certification of a cleanroom as ready for use, it appears that even this requirement was handled improperly. At a minimum, ISO 14644-1 requires testing of a newly constructed cleanroom in the "as built" condition, followed by later testing in the "at rest" or "operational" condition. Liberty Industries correctly identified that they would test the cleanroom in the "at rest" condition, but failed to test even in the less stringent "as built" condition, as testing was apparently performed while significant aspects of the cleanroom construction remained unfinished.

50. The fact that the certification tests showed that the cleanrooms were in compliance with ISO 14644-1 should not be used to conclude that the cleanrooms were properly constructed to meet their designed specifications. When building a cleanroom, it is imperative that other standards, such as ISO 14644-4, are followed to ensure proper operation of the cleanroom for its intended purpose. To simply use ISO 14644-1 as the sole criterion to determine whether a cleanroom is acceptable demonstrates a lack of understanding of the criteria to be used to determine whether a cleanroom is constructed and operating properly. In addition to being able to meet the requirements for airborne particulate testing per ISO 14644-1, the cleanroom must also be properly constructed. This includes the use of appropriate construction materials and the correct use and installation of these materials to prevent external contaminants from easily entering into the cleanroom.

D. Relationship between the Defects in Cleanroom 1 and the Contaminated Vials of MPA

51. As with any biological contamination event, such as that which occurred with the contaminated vials of MPA at NECC, there are a number of possible causes. Sufficient evidence exists to conclude that the fungal contamination occurred during some aspect of the compounding process at NECC. Due to the number of possible causes for the contamination during the compounding process, it is unlikely that any definitive path of fungal contamination from an originating source to its final destination in the vials will be able to be identified. At best, only after a thorough investigation process, likely contamination paths can be identified and assigned various levels of probability.

52. It has been brought to my attention by plaintiff's counsel that defense counsel for Liberty Industries has argued that if the defects in the construction of the cleanroom were responsible for the contamination of the three MPA lots, it is probable that more than three batches of drugs would have been contaminated. This argument demonstrates a lack of understanding of cleanrooms and how contamination occurs. It is precisely the fact that the contamination occurred on only a few occasions which supports the conclusion that the defects in the cleanroom ceiling were the likely source of the fungus contamination in the cleanroom. Based on the nature of the defects in the ceiling, it is likely that the contamination was intermittent and coincided with debris falling on top of the cleanroom ceiling, changes in the building air pressure, or vibrations which could move particles from on top of the ceiling through the gaps in the ceiling. The degree and magnitude of the contamination entering the cleanroom would likely have varied significantly over time, and worsened as the cleanroom aged, as more debris collected above the ceiling. As a result, one would expect the impact of the defects in the ceiling to be an intermittent effect which would likely have become more severe over time.

VII. CONCLUSIONS

53. It is my opinion, to a reasonable degree of scientific certainty, that Cleanroom I, designed and constructed by Liberty Industries, was improperly designed and installed to ensure its intended use for the compounding of sterile injectable drugs. As the primary contractor responsible for the finished cleanroom, Liberty Industries was responsible for ensuring that the clcanroom was properly constructed, in all aspects, to be able to provide the required cleanliness environment for compounding sterile injectable drugs.

54. Based on the evidence currently available to me which includes my observations of these defects in the ceiling of the clcanroom, the size and composition of the debris observed in the area of these defects, and my understanding of the likely operations performed in the cleanroom in the area of these defects, it is my opinion, to a reasonable degree of scientific certainty, that Liberty's failure to design and construct Cleanroom 1 was a proximate cause of the fungal contamination in NECC's cleanroom.

This Declaration is based on my personal knowledge, except when stated otherwise, and if called upon to testify, I am competent to testify to the matters contained herein. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on January 14, 2015

Dr. Philip J. Austin, Ph.D.

DR. PHILIP J. AUSTIN, PH.D.

Dated: January 14, 2015

Subscribed and sworn before me this 14th day of January, 2015.

Jeanette Hamilton
Notary Public of Michigan
Oakland County
Expires 03/15/2019
Acting in the County of OAKLAND

Curriculum Vitae
of
Philip J. Austin, Ph.D.

11844 Brookfield
Livonia, MI 48150

Summary:

Dr. Austin is an expert in the field of cleanrooms and contamination control. As the son of the original cleanroom expert and pioneer in the field of cleanroom technology, Dr. Philip R. Austin, Dr. Philip J. Austin has been working in cleanrooms and with cleanroom technology since his childhood. He literally grew up in and around cleanrooms, and his work with cleanrooms continues to the present day. As an adolescent, Dr. Austin assisted his father with various cleanroom related projects with the family owned business which designed and manufactured cleanrooms and cleanroom components, and provided custom precision cleaning services for the aerospace industry. As an engineering student at The University of Michigan, pursuing undergraduate and graduate degrees in Aerospace Engineering, Dr. Austin collaborated with his father to write and illustrate training handbooks used in training seminars on the design and operation of cleanrooms. Dr. Austin also assisted in the editing of several of his father's books on the subject of cleanrooms. Upon completion of his Ph.D. in Aerospace Engineering, Dr. Austin accepted a prestigious National Research Council postdoctoral appointment at the National Institute of Standards and Technology in Gaithersburg MD.

After completion of his postdoctoral appointment in 1996, Dr. Austin returned to Michigan to work with his father to expand the family owned business, Acorn Industries, as Director of Research. Acorn Industries provides services based on the expert knowledge of both Drs. Austin in the area of cleanrooms, cleaning, and contamination control. The company provides precision cleaning and contamination testing services performed in their cleanrooms, cleaned containers for the fluid power, medical device, and pharmaceutical industries, and consulting services for cleanroom design and operation as well as for troubleshooting of contamination issues.

As Director of Research of a small business for the past 18 years, Dr. Austin has been responsible for the majority of engineering activities which include cleaning process development, design of cleanroom facilities and custom cleaning equipment, technical sales, and consulting services for troubleshooting of contamination issues. During his tenure at Acorn Industries, Dr. Austin has worked with hundreds of customers in the pharmaceutical, medical device, and other cleanroom related industries as an expert resource to assist them with custom solutions to their unique contamination control issues. Dr. Austin has provided both formal and informal consulting services to assist clients with defining cleanliness requirements, troubleshooting contamination issues, and developing cleaning processes. Dr. Austin has also worked closely with his father in providing additional formal consulting services for cleanroom training, cleanroom design, and troubleshooting cleanroom manufacturing contamination issues.

Education:

Doctor of Philosophy, Aerospace Engineering: The University of Michigan, Ann Arbor, 1994.

Master of Science in Engineering, Aerospace Engineering: The University of Michigan, Ann Arbor, 1990.

Bachelor of Science in Engineering, Aerospace Engineering: The University of Michigan, Ann Arbor, 1988.

Engineering Experience:

Acorn Industries
Livonia, Michigan
Director of Research / Vice-President: 2010 - Present
Director of Research: 1996 – 2010

Supervised and performed engineering activities related to custom precision cleaning services, container cleaning services, and cleanroom consulting services. Acorn Industries is a small business dedicated to providing various cleanroom services related to the control and removal of contamination. Performed research to develop hundreds of cleaning processes specific to unique customer requirements for precision parts cleaning and container cleaning. Wrote and revised more than 1,000 technical procedures and SOPs for cleaning processes, testing methods, validations, and cleanroom operations. Served as primary sales contact and technical resource for new projects with advanced technical requirements. Worked directly with customers in the pharmaceutical and medical device industries to develop custom solutions for their parts cleaning and cleaned container system requirements. Provided formal and informal consulting services to clients to assist with defining cleanliness requirements, troubleshooting contamination issues, and developing cleaning processes. Worked with pharmaceutical manufacturers and compounding pharmacies to provide technical support for their filling operations and regulatory compliance. Provided quality system management support and assistance with technical and regulatory issues. Performed and supervised validations of cleaning, depyrogenation, and sterilization processes for container and closure systems for the pharmaceutical industry. Designed and supervised construction and expansion of Acorn's cleanroom facilities. Designed custom cleaning process equipment and supervised its construction and validation. Provided cleanroom training to Acorn employees and assisted with training of consulting clients. Provided technical support for cleanroom design and certification activities for consulting clients.

National Institute of Standards and Technology (NIST)
Gaithersburg, MD
NRC Postdoctoral Research Fellow: 1994 - 1996

Performed unique research in the field of fire safety and combustion of materials. Worked on independent research projects and collaborative projects with senior researchers from the government and industry.

The University of Michigan, Department of Aerospace Engineering
Ann Arbor, MI
Teaching Assistant / Supervising Teaching Assistant: 1991 - 1993

Taught the senior level Aerospace Engineering lab course. As Supervising Teaching Assistant, revised curriculum, supervised the teaching laboratory classroom, and supervised the teaching of the course by other teaching assistants.

The University of Michigan, Department of Aerospace Engineering
Ann Arbor, MI
Research Assistant: 1988 - 1991

Performed unique research in the field of combustion of small dust particles under the supervision of professors in the department of Aerospace Engineering.

National Aeronautics and Space Administration (NASA)
Lewis Research Center
Cleveland, OH
Engineer: 1985 - 1987

Worked on various engineering projects related to the design of the electrical power system for the International Space Station. Developed the experimental package for a biological experiment for the Space Shuttle and prepared it for launch. Worked with senior engineers on various heat transfer experiments.